



# DUAL POLARIZATION INFORMATIONAL GUIDE

FOR BROADCASTERS  
IN MID-ATLANTIC REGION

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# Overview/ Background

The entire fleet of WSR-88Ds will be outfitted with Dual Polarization (“Dual Pol”) technology by 2013 (*already installed on KLWX*). This is biggest single upgrade to these radars since their deployment.

Dual polarized beams scan targets in both vertically and horizontally. This allows the radar to differentiate between not only between weather and non-weather echoes, but rain, snow and hail.

There are 3 base products:

- ***Differential Reflectivity (Zdr)***
- ***Correlation Coefficient (cc)***
- ***Specific Differential Phase Shift (kdp)***

And 2 derived products:

- ***Melting Layer (ML)***
- ***Hydrometeor Classification (HC)***

Each of these products have their own characteristic uses (explained in the next few pages).

The NWS has created brief online training modules are available and give a good overview of these products and their uses. Go to the “Training for Non-NWS Meteorologists” section:

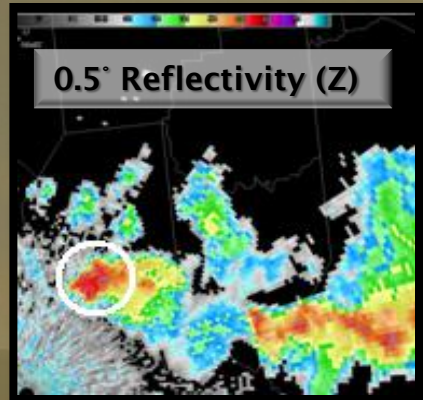
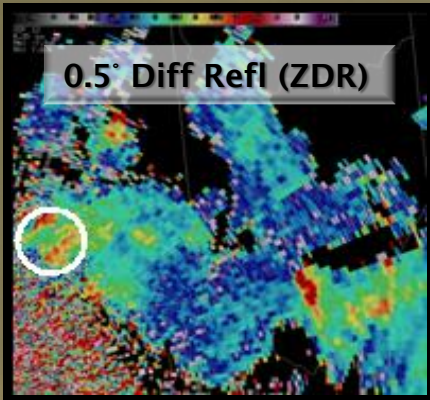
<http://www.wdtb.noaa.gov/courses/dualpol/outreach/>



# Products

## Differential Reflectivity (ZDR)

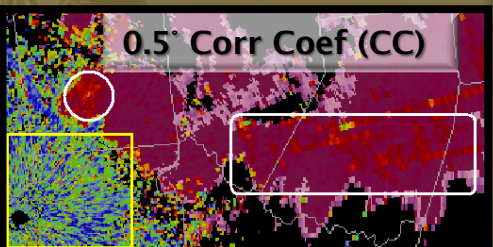
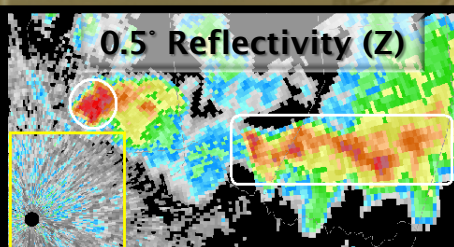
ZDR can be considered the “opposite” or “anti” reflectivity. It tries to show the dBZ difference in certain types of echoes. Big rain drops will have high ZDR values while non-precip. echoes and even hail will have low ZDR values. The white circle in the images below show where hail is being detected (in the left ZDR image) in the middle of a heavy rain shaft.



## Correlation Coefficient (CC)

CC also discriminates between precip. and non-precip. echoes, which can affect radar-estimated rainfall and snowfall amounts. The above-right image is regular reflectivity and the above-left is the CC product.

The areas in the white boxes show where higher reflectivity is corresponding with large rain drops and possibly small hail, whereas the lighter and smaller rain drops are assigned more uniform color. The yellow rectangle on the bottom left of each image corresponds to the ground clutter surrounding the radar.

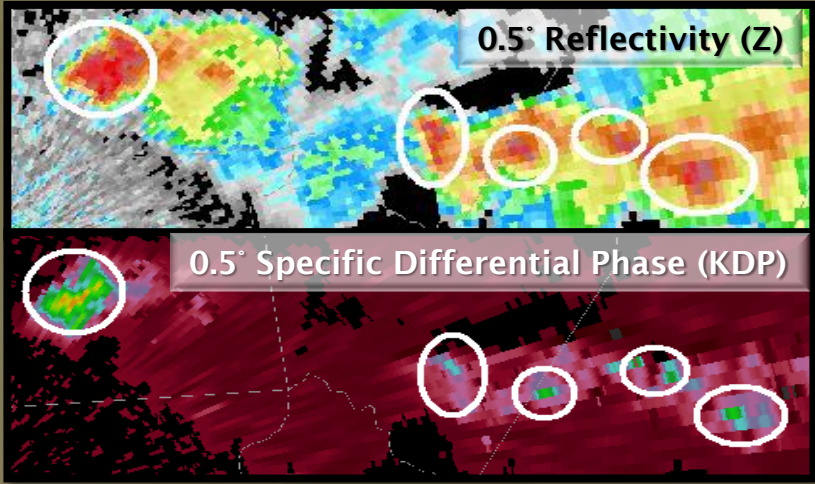




# Products

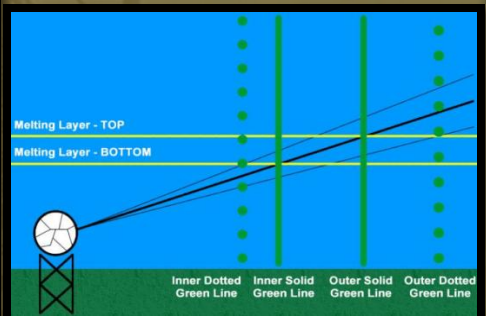
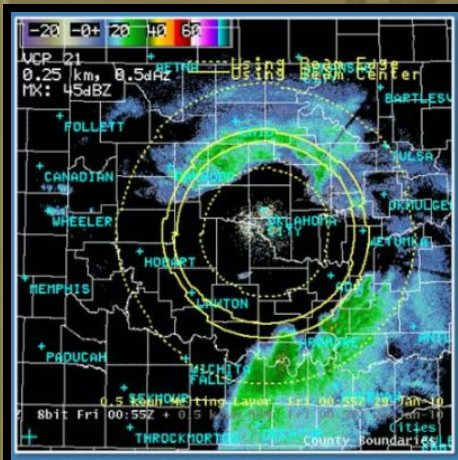
## Specific Differential Phase [Shift] (KDP)

KDP establishes where hail and ice crystals are forming and falling in a cloud. The image below is a good example of a recent case near Pittsburgh, PA. The white circles indicate where there may be hail in the storms, especially the larger storm on the left-hand side of the image.



## Melting Layer (ML)

ML is a visual depiction of the approximate “melting layer” or level in the atmosphere, several concentric circles. There is an upper bound, a lower bound. The left image is the basic product, which displays the approximate location in the scan where the Melting Layer starts and where it ends. Areas of precipitation outside the larger circles are probably snow/ice crystals, while those inside the smaller circles are likely melted precipitation, or rain.

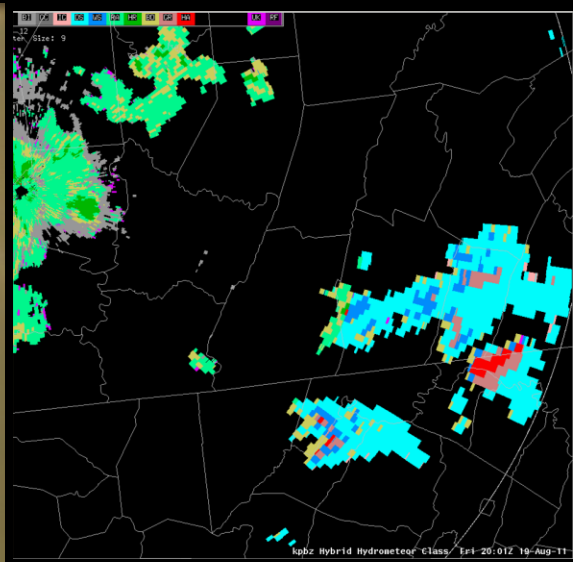


# Products

## Hydrometeor Classification Algorithm (HC)

HC is the simplest and most useful product in the Dual Pol suite. This is a product that assigns a color and classification to every pixel of precipitation/non-precipitation on the scope. For example, if there was a thunderstorm of any shape or areal size, the HC will differentiate between hail, rain (different sizes), snow (wet or dry), and various forms of AP (ground clutter).

BI GC IC DS WS RA HR BD GR HA UK RF													
HCA													
Biological Scatters	Birds, Bats, Insects: Low reflectivity (Z), very high ZDR, very low CC												
Ground Clutter/AP	High Z, low CC and ZDR. Velocity must be less than +/- 2 kts												
Ice Crystals	Plates, Columns, Needles: Low reflectivity, very high CC, positive ZDR												
Dry Snow	Aggregated Crystals: Similar dual-pol values as with Ice Crystals but with a lower ZDR												
Wet Snow	Bright band/melting snow: Much lower CC, higher Z and ZDR than Dry Snow												
Light/Mod. Rain	Rain rates less than 1.1 in/hr. Positive KDP, ZDR, Z < 45 dBZ												
Heavy Rain	Rain rates greater than 1.1 in/hr. Positive KDP, ZDR, Z > 45 dBZ												
Big Drops	Large drops in small concentrations. Very high ZDR, low Z. Seen along storm edges.												
Graupel	Round or conical snow pellets < 5 mm diameter. High CC and ZDR < 2 dB												
Hail-Rain	Hail Possibly Mixed with Rain: High Z, Low ZDR, Lower CC												
Unknown	Confidence in any particular classification is too low to make a guess												
Range Folding	Unlikely to show up in dual-pol products												



Above image: Example of the HC product from KPBZ (Pittsburgh, PA). The green echoes closer to the radar are different intensities of rain. As the beam goes higher, further from the radar (over South-Central PA and Western Maryland), the radar is detecting ice crystals above the melting layer and even hail (red).

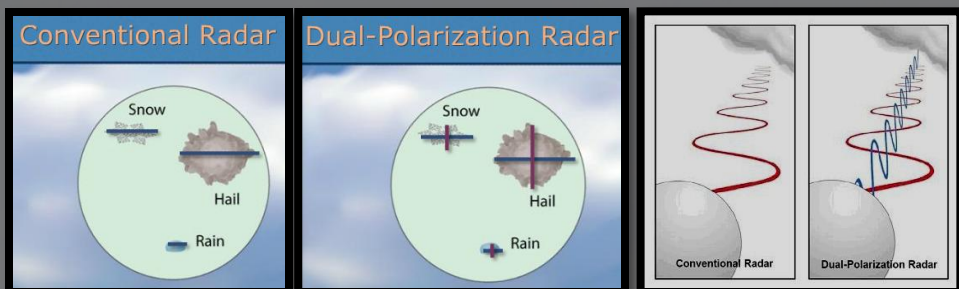


# Q & A

**Q:** What is Dual Pol and what benefits will it provide?

**A:** Dual Pol technology has been around (in testing) for several years and now just now being deployed to all 88Ds (2011-2013). It is a biggest upgrade to the 88D network since it began in the early 1990s.

Dual Pol products give forecasters a new, more accurate set of tools to determine what is in a cloud (at any level) and what is not from a cloud (ground clutter). It allows us to detect certain features like thunderstorm updrafts, tornadic debris signatures, and certain winter precipitation echoes. Perhaps the greatest advantage will be enhanced rainfall estimation.



**Q:** Will I lose my current radar products or notice any substantial changes in them?

**A:** No, nothing changes to the current suite of products (Refl., Vel, VIL, precip. accumulation, etc.). Dual Pol essentially just adds a new suite of products to these legacy base products.

**Q:** What is the difference between how the current radar and how Dual Pol scan the atmosphere?

**A:** Conventional (current) radar beam only collects information in the horizontal. It only gathers information about the relative size of objects. A Dual Pol beam collects data in both the horizontal and vertical directions, providing us with information about the size, shape and variety of objects.

**Q:** What are some societal impacts of Dual Pol technology

- Potentially save the public nearly \$700 mil annually by improving precipitation estimation
- Improve forecasts and warnings, reducing the impact of hazardous weather on our national transportation
- Better equip forecasters to issue more accurate warnings and in turn help the public make wiser decisions about safety

From NSSL Dual Pol web page:

<http://www.nssl.noaa.gov/research/radar/dualpol.php>

# Contact Info.

If you have any questions, concerns, or would like any other Dual Pol reference material, please contact us:

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As always, you can contact the office 24/7:

703-996-2202

or

703-996-2200 (Option 2)